APPARATUS AND METHODS FOR CONVEYING OBJECTS

TECHNICAL FIELD

[0001] The invention generally relates to power-driven conveyors.

DESCRIPTION OF THE RELATED ART

[0002] Switch conveyors have been developed that include a modular conveyor belt that includes rows of rollers. The rollers are disposed in the modular conveyor belt and are angled relative to the direction of travel of the belt such that they can laterally divert objects placed on the belt. The conveyor includes fixed longitudinal wear strips that are located below the conveyor belt. As the conveyor belt travels, the rollers travel along the longitudinal wear strips causing the rollers to rotate for the purpose of diverting objects.

[0003] The use of the wear strips to rotate the rollers causes the rollers to slip in that the rollers intermittently slide along the wear strips. Such slippage is undesirable in that it results in inconsistent or inefficient diverting of the objects.

SUMMARY

[0004] Disclosed are conveyors and methods for conveying objects. In one embodiment, a conveyor comprises a modular conveyor belt that includes a plurality of mat-top chains having a plurality of cavities and a plurality of first rollers disposed in the cavities of the mat-top chains. The conveyor further includes at least one second roller that operatively couples to the first rollers such that the first rollers rotate as the conveyor belt travels along the second roller.

[0005] In one embodiment, a method comprises driving a modular conveyor belt in a direction of belt travel; rotating a plurality of first rollers disposed into the modular conveyor belt in a manner in which slippage of the first rollers is reduced; and conveying objects on the modular conveyor belt using the rotating first rollers.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] The disclosed apparatus and methods can be better understood with reference to the following drawings. The components in the drawings are not necessarily to scale.

[0007] FIG. 1 is a perspective view of an embodiment of a section of a conveyor that includes a conveyor belt having a plurality of first rollers that are operatively coupled to a second roller.

[0008] FIG. 2 is a detail view of a section of the conveyor of FIG. 1.

[0009] FIG. 3 is a top view of an embodiment of a section of the conveyor of FIG. 1.

[0010] FIG. 4 is a front view of an embodiment of a section of the conveyor of FIG. 1.

[0011] FIG. 5 is a flow diagram that illustrates an embodiment of a method for conveying objects.

[0012] FIG. 6A is a perspective view of an example embodiment of a first roller.

[0013] FIG. 6B is a side view of the roller of FIG. 6A.

DETAILED DESCRIPTION

[0014] Disclosed are conveyors and methods for conveying objects that reduce slippage of conveyor rollers. Due to that reduced slippage, the conveyors more effectively divert objects on the conveyor belt. In some embodiments, the conveyor includes first rollers disposed in the conveyor belt and at least one second roller located underneath the conveyor belt that can rotate in a direction transverse to the direction of travel of the conveyor belt. As the conveyor belt travels along the second roller, the second roller operatively couples with the first rollers causing the first rollers and the second roller to rotate. Because of the rotation of the second roller, the first rollers rotate with reduced slippage.

[0015] Referring now in more detail to the figures in which like referenced numerals identifying corresponding parts, FIG. 1 illustrates a perspective view of an embodiment of a section of a conveyor 100 in which a plurality of first rollers 104 are disposed in a conveyor belt 102. As indicated in this figure, the conveyor belt 102 is modular and includes at least one mat-top chain 110. The mat-top chain 110 has a plurality of cavities 114, in which the first rollers 104 are disposed. By way of example, the first rollers

comprise plastic wheels that include outer rubber layers or tires (see discussion of FIGs. 6A and 6B). That configuration increases friction between the first rollers 104 and surfaces that the rollers contact (i.e., the surfaces of the second rollers 106 described below) so as the reduce slippage of the first rollers. The first rollers 104 are aligned at an angle α (shown in FIG. 3) relative to the direction of the travel of the conveyor belt 102 so as to laterally divert objects conveyed by the conveyor belt. By way of example, α may range from approximately 20 to 70 degrees. Because the first rollers 104 are used to divert objects, the first rollers may be designated as diverting rollers. The mat-top chain 110 of FIG. 1 includes hinge elements 112 that can be used to link other mat-top chains 110 to form a continuous conveyor belt 102.

[0016] With further reference to FIG. 1, the conveyor 100 further includes a plurality of second rollers 106 and support members 108. The second rollers 106 are located underneath the conveyor belt 102 between the support members 108 and are free to rotate in a direction that is transverse, e.g., substantially perpendicular, to the direction of travel of the conveyor belt indicated by arrow A. By way of example, the second rollers 106 comprise elongated metal rollers that include eurethane outer sleeves. Because the second rollers 106 rotate in a direction that is transverse to the direction of travel of the conveyor belt 102, the second rollers 106 may be designated as transverse rollers. As the conveyor belt 102 travels in direction A along the second rollers 106, the second rollers can be positioned to engage the first rollers 104. Such engagement causes the first rollers 104 and the second rollers 106 to rotate. That rotation is facilitated by the high coefficient of friction that exists between the rubber layers of the first rollers 104 and the eurethane sleeves of the second rollers 106. As the first rollers 104 rotate along the second rollers 106, the first rollers pass over from first ends 118 to second ends 120 of the second rollers to trace a helical path 308 (shown in FIG. 3) on the second rollers. Because the second rollers 106 rotate when they engage the first rollers 104 as opposed to being fixed as prior art wear strips, the first rollers rotate with reduced slippage. In fact, after an initial start up period, the first rollers 104 rotate along the second rollers 106 with nearly no slipping. This, in turn, enables more effective diverting of the objects carried

by the conveyor belt 102. For example, objects can be diverted more quickly, in a shorter amount of space (i.e., length of conveyor), or both.

[0017] In some embodiments, the second rollers 106 are vertically displaceable so as to be capable of being moved toward or away from the mat-top chain 110 to engage or disengage the first rollers 104. The vertical movement of the second rollers 106 can be facilitated by various components such as an air actuator, hydraulic actuator, ball screw actuator, or solenoid actuator. Alternatively, however, in cases in which the first rollers 104 are always to be driven, the second rollers 106 are not displaceable such that they continuously engage the first rollers as the conveyor belt 102 travels in direction A. In yet a further alternative, the second rollers 106 are horizontally displaceable so as to be brought into an out of contact with first rollers 104. Such an arrangement may be particularly advantageous in situations in which the conveyor belt is provided with transverse rows of first rollers 102 that alternatingly face different directions (e.g., a leftward direction, rightward direction, the leftward direction, and so forth across the row)). Horizontal displacement of the second rollers 106 in such a case may enable switching between diversion of objects in two separate (e.g., opposite) directions (e.g., from a leftward direction to a rightward direction and vice versa).

[0018] FIG. 2 is a detailed view of a section of the conveyor of FIG. 1. As shown in FIG. 2, the mat-top chain 110 includes hinge elements 112 that have multiple interleaved hinge elements 206, each of which has a hole 208 that is axially aligned with the hole 208 of an adjacent element 206. In order to link two mat-top chains 110, the axially-aligned holes 208 of the chains 110 are aligned and a rod (not shown) is placed through the axially-aligned holes 208. A plurality of mat-top chains 110 may therefore be linked together to form a continuous conveyor belt 102.

[0019] As described above, the mat-top chain 110 further includes cavities 114 in which the first rollers 104 are disposed and in which the first rollers can rotate. As the conveyor belt 102 travels in direction A, the second rollers 106 can be made to engage the first rollers 104 causing the first rollers to rotate in direction B. The objects on the conveyor belt 102 can therefore be conveyed in a direction C. Notably, the second rollers rotate in direction D.

[0020] FIG. 3 is a top view of an embodiment of a section of the conveyor of FIG. 1. In FIG. 3, the first rollers 104 are arranged along the axes 302. The mat-top chain 110 includes first roller axles 306 that are aligned on the rotational axes 304. The first roller axles 306 are coupled with the mat-top chain 110 and disposed within the cavities 114. The first roller axles 306 extend through openings of the first rollers 104 to enable the first rollers 104 to rotate about their axes 302 when engaged with the second rollers 106. The alignment of the first rollers 104 enables the first rollers 104 from below to convey objects on the conveyor belt 102 at an angle α relative to the direction of travel A.

[0021] As is further depicted in FIG. 3, the second rollers 106 are located underneath the conveyor belt 102 such that the second rollers 106 can engage the first rollers 104 from below as the belt travels in direction A along the second rollers 106.

[0022] FIG. 4 is a front view of an embodiment of a section of the conveyor of FIG. 1. The mat-top chain 110 has a height dimension 402 that is smaller than the height dimension 404 of the first rollers 104. As the belt 102 travels in direction A and the first rollers 104 engage the second rollers 106, the first rollers rotate in direction B and the second rollers 106 rotate in an opposing direction D (counterclockwise in the orientation shown in FIG. 4).

[0023] FIG. 5 is a flow diagram that illustrates an embodiment of a method 500 for conveying objects on a conveyor belt. Beginning with block 502 of FIG. 5, the method 500 includes driving a conveyor belt in first direction.

[0024] In block 504, first rollers within the conveyor belt are rotated in a manner in which slippage of the first rollers is reduced. For example, as the conveyor belt travels in direction A, the first rollers engage second rollers that are likewise free to rotate.

[0025] In block 506, the objects on the conveyor belt 102 are diverted in a second direction using the first rollers. The objects can be displaced towards either the sides or the middle of the conveyor belt.

[0026] FIGs. 6A and 6B illustrate an example embodiment for the first rollers described above. As indicated in these figures, a roller 600 comprises an inner wheel 602 surrounded by an outer tire 604. By way of example, the inner wheel is constructed of a lightweight, rigid material, such as a plastic or metal, and the outer tire 604 is made of a

resilient material having a high coefficient of friction, such as a rubber. The outer-tire 604 is provided around an outer surface 608 of the inner wheel 602 (FIG. 6B). The inner wheel 602 also comprises an opening 606 through which a roller axle may pass to rotatably mount the roller 600 in a conveyor belt (e.g., belt 102). Due to the outer tire 606, improved gripping of a surface, such as that of the second rollers, can be achieved thereby reducing slippage.

[0027] It should be emphasized that the above-described embodiments are merely possible examples. Many variations and modifications may be made to the above-described embodiments. All such modifications and variations are intended to be included herein within the scope of this disclosure.